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INFORMATION gained through
work of the United States Depart-
ment of Agriculture, Showing the
Value of Citrus Trees Propagated
from Superior Record-Performance
Parents



Southern California Nurseries

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UNTIL 1876 NOT ONE DOCTOR AMONG THOUSANDS KNEW WHAT CAUSED CONTAGIOUS DISEASE. IT WAS IN THAT YEAR—LESS THAN FIFTY YEARS AGO—THAT LOUIS PASTEUR, GREAT FRENCH SCIENTIST, STARTLED THE WORLD BY ANNOUNCING HIS WONDERFUL DISCOVERY OF GERMS AS A CAUSE OF DISEASE. IT WAS THE KEY TO THE MYSTERY OF THE CAUSE AND PREVENTION OF CONTAGIOUS DISEASES. IT MADE POSSIBLE THE TREMENDOUS ADVANCES WHICH HAVE TAKEN PLACE IN A SCANT HALF CENTURY.

GOLDEN YEARS OF PROGRESS FOLLOWED. THE HISTORY OF MEDICINE FROM THAT TIME READS LIKE A ROMANCE—A WONDERFUL STORY OF ACHIEVEMENT, OF WORK AND STRUGGLE, DISAPPOINTMENT AND HOPE—AND CONSTANT FIGHT AGAINST THE IGNORANCE WHICH CLOAKED DISEASES. AMAZING DISCOVERY CROWDED UPON DISCOVERY. ALL FORMER CONCEPTIONS OF DISEASE WERE REVOLUTIONIZED BY THE WONDERFUL WORK OF THESE HEALTH HEROES, PASTEUR, KOCH, LISTER, AND THEIR FOLLOWERS. IN JUST FOUR SHORT YEARS, FROM 1880 TO 1884, WERE DISCOVERED THE GERMS OF PNEUMONIA, TYPHOID, TUBERCULOSIS, CHOLERA, ERYsipelas, DIPHTHERIA AND TETANUS, USUALLY CALLED LOCKJAW. IN 1900 CAME WALTER REED'S TRIUMPHANT WORK IN CUBA WHICH RESULTED IN LOCATING A PARTICULAR MOSQUITO AS THE CARRIER OF THE GERM OF YELLOW FEVER.

(Outlook, August 26, 1925. Advertising Section.)

THIS booklet is printed to tell you about Citrus Trees and to let you know what we have to sell. From bulletins of the United States Department of Agriculture we quote results of experiments and studies by Mr. A. D. Shamel and his co-workers; in this way we can give growers of Citrus Fruits useful information.

All illustrations are from photographs taken in the orchards of Southern California by Mr. Shamel.

Leading Citrus Growers tell us that their great advance during the past fifteen years is due to the help of the United States Department of Agriculture, the Citrus Experiment Station of California, and the California Fruit Growers Exchange.

ACTING upon the request of some of the leading citrus growers in Southern California, the Bureau of Plant Industry in 1909 began an investigation, for the purpose (1) of ascertaining the variations which have taken place in the important commercial citrus varieties grown in California through bud variations and to learn the comparative value of the different strains arising from these variations for commercial fruit production; (2) to determine the extent to which undesirable variations have been propagated, as shown by the percentage of such undesirable trees existing in the parent bearing orchards; and (3) through improved methods of propagation to reduce the number of undesirable variations which enter into commercial citrus-fruit orchards.¹

These investigations have been carried on by means of records and observations of individual trees. The term "performance record" is here used to mean the record of the number and commercial quality of fruits borne by individual trees during a period of years. Mostly these studies were made in performance-record plats, consisting of groups of trees grown under comparable conditions, selected for the purpose of determining the behavior of the trees by means of individual-tree records of production, observations, descriptive notes, and photographs.¹

The object of the commercial tree records is (1) to locate the drone trees, or those of the inferior strains in the orchards; (2) to find the superior trees, or those from which bud wood may be secured for propagation; (3) to aid in giving the trees individual care, such as cutting out limb sports or other undesirable growth, treatment for disease, or any tree injury; and (4) to secure definite evidence as to the effect of cultural treatments and other experimental tests.¹

THE ESTABLISHED AND PROVED CITRUS VARIETIES ARE THE MOST VALUABLE POSSESSION OF THE CITRUS INDUSTRY. The conservation, standardization, and stabilization of these varieties should receive most careful consideration by citrus propagators and growers.²

1. A. D. Shamel in Yearbook of United States Department of Agriculture, 1919.

2. A. D. Shamel in Farmers Bulletin 749, United States Department of Agriculture.

During recent years many California citrus growers have noticed the presence of undesirable trees in their orchards. This condition seemed more apparent in young orchards, or those farther removed from the original trees from which the varieties developed than in the older orchards which were more closely related to the original parent trees. MANY OF THESE TREES APPARENTLY PRODUCED IRREGULAR, LIGHT CROPS OF INFERIOR QUALITY. In some cases the commercial and eating quality of the fruit from the off-type trees proved to be so poor that it became necessary to sort them out from the general crop and throw them into the cull bins.¹

One of the first and most important individual fruit variations observed in Washington Navel orange trees was a large, coarse fruit, which is commonly called an Australian Navel orange. Soon after the discovery of this single fruit variation in the crop of a typical Washington Navel tree, a limb was found in a near-by Washington Navel tree bearing fifty-six typical Australian fruits. A further study of this orchard revealed several trees bearing all, or nearly all, Australian fruits, and having the peculiar upright habit of growth so characteristic of the trees of this strain.¹ Refer to illustration on page 4.

In these studies IT WAS FOUND THAT THE TREES OF THE BEST WASHINGTON NAVEL STRAIN PRODUCED AN AVERAGE OF 4.73 PACKED BOXES OF ORANGES PER TREE PER YEAR during the period of observation. Under similar conditions the trees of the Australian strain PRODUCED 0.76 OF A PACKED BOX PER TREE PER YEAR. On an acre basis, this yield amounted to 378.6 packed boxes per acre for the best trees, compared with 61 packed boxes per acre for the inferior trees. THE ACTUAL VALUE OF THIS PRODUCTION WAS \$635.05 PER ACRE ANNUALLY for the high-producing trees, as COMPARED WITH \$100.04 FOR THE LOW-PRODUCING TREES of the undesirable strain. Even greater differences in production and value of the crops from the trees of different strains have been found in other varieties. WHEN IT IS REMEMBERED THAT ON THE AVERAGE 25 PER CENT OF THE TREES IN THE ORCHARDS STUDIED HAVE BEEN FOUND TO BE INFERIOR STRAINS, THE COMMERCIAL IMPORTANCE OF GROWING ONLY TREES OF THE BEST STRAINS CAN BE APPRECIATED.¹

1. A. D. Shamel in Yearbook of United States Department of Agriculture, 1919.



FIGURE 1
On the right, a typical Australian Navel tree, propagated from a limb sport of this character, in an otherwise normal parent. The few fruits produced by this tree have been coarse, variable in size, and worthless in competition. On the left, a productive and profitable Navel tree, propagated from a fruiting normal branch of the same parent. Fruits from this tree have been uniformly good in all characteristics. This illustrates the origin of the Australian type through careless propagation from limb sports, and shows the great importance of propagating only uniformly productive limbs.

PROGENY TESTS OF BUD VARIATIONS

IN ORDER to determine whether or not strains may arise as limb variations and be perpetuated through budding, propagations were made in the spring of 1915 of a number of limb sports which were typical of the important established strains, together with propagations of many entire tree variations. The buds secured from these sports were inserted in sour orange stocks and the trees were grown in co-operation with the Citrus Experiment Station of the University of California. In July, 1917, a part of the progeny trees grown from these propagations were planted on the Station grounds at Riverside.

In order to illustrate the results of these important progeny tests, a typical example in the Washington Navel orange will be given. In this study three progeny trees from an unproductive limb have produced a total of 64 fruits in the five seasons since they came into bearing—an average of 4.2 fruits per tree each year—while two progeny trees from a normal limb of the same parent produced during the same five seasons, since they came into bearing, 943 fruits, an average of 94.3 fruits per tree per year.³

Details are shown in the following table:

SEASON	Number of Oranges produced by the progeny of the unproductive limb			Number of Oranges produced by the progeny of the normal limb	
	TREE One	TREE Two	TREE Three	TREE Four	TREE Five
1920-21	1	3	0	18	50
1921-22	0	0	0	61	60
1922-23	0	0	1	56	72
1923-24	28	16	15	173	262
1924-25	0	0	0	99	92
	—	—	—	—	—
TOTALS	29	19	16	407	536

Normal limb—943. Unproductive limb—64.

The behavior of the progenies as a whole offers most striking and conclusive proof of the value and importance of bud selection in citrus propagation, and the wisdom of the methods which have been almost universally adopted in commercial propagation in the Southwest in selecting bud wood from uniformly productive and superior parent trees.³

The trees of one of the strains of the Eureka lemon variety possess unusual vigor of growth and habitually bear light crops of inferior fruits. On account of their large size, as compared with the trees of the productive strain, the density of their

1. A. D. Shamel in Yearbook of United States Department of Agriculture, 1919.

3. A. D. Shamel in Journal of Agricultural Research, Vol. XXVI, No. 7.

foliage, and their poor crops, they have been called shade trees. These trees usually develop a very large number of rank, upright-growing, non-fruiting branches, commonly called suckers. Formerly this sucker growth was generally used by citrus nurserymen for propagation. In one of the older Eureka lemon orchards in Southern California 10 per cent of the trees were found to be of the Shade-Tree strain. In a younger orchard, THE TREES OF WHICH HAD BEEN GROWN FROM SUCKER BUDS SECURED IN THE OLDER GROVE, 25 PER CENT OF THE TREES WERE FOUND TO BE OF THIS STRAIN. IN A STILL YOUNGER ORCHARD, WHERE THE TREES HAD BEEN GROWN FROM SUCKER BUDS SECURED IN THE SECOND ORCHARD, THE PERCENTAGE OF SHADE TREES WAS FOUND TO BE 75.¹ Refer to illustrations on pages 8 and 9.

This astonishing increase in the percentage of shade trees in the younger orchards is due to the fact that the bud cutters in each instance secured a large share of their bud wood from the trees of the Shade-Tree strain.¹

What has been demonstrated is that variation can be controlled by bud selection to such an extent that the individuals of the strain can be brought to a condition of practical uniformity as regards crop production and other characteristics. At this time there are several thousand acres of bearing citrus orchards in California in which the trees have been propagated from carefully selected buds, secured from superior performance-record trees. Performance-record studies of these progenies, AND A COMPARISON OF THEIR BEHAVIOR WITH THAT OF THE PARENT TREES, CONCLUSIVELY DEMONSTRATE THAT THROUGH BUD SELECTION EACH OF THE IMPORTANT CITRUS STRAINS HAS BEEN ISOLATED. THE UNIFORMITY OF THE PROGENIES AND THE SUPERIOR AND HEAVY CROPS OF THOSE OF DESIRABLE STRAINS HAVE PROVED BEYOND ANY DOUBT THAT IT IS PRACTICABLE COMMERCIALLY TO ISOLATE AND PROPAGATE ONLY THE BEST STRAINS AND TO ELIMINATE THE INFERIOR ONES THROUGH CAREFUL BUD SELECTION, BASED UPON INDIVIDUAL-TREE RECORDS AND INTIMATE TREE KNOWLEDGE.¹

ENOUGH EVIDENCE HAS BEEN SECURED TO WARRANT THE ASSERTION THAT ALL THE STRAINS OF EACH OF THE CITRUS VARIETIES DISCOVERED IN THESE INVESTIGATIONS CAN BE ISOLATED THROUGH BUD SELECTION.¹

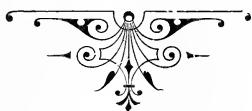
The results of the extensive progeny tests which have been carried on prove that THE QUANTITY OF FRUIT PRODUCED BY CITRUS TREES IS A TRANSMITTABLE CHARACTER, CAPABLE OF

1. A. D. Shamel in Yearbook of United States Department of Agriculture, 1919.
3. A. D. Shamel in Journal of Agricultural Research, Vol. XXVI, No. 7.

PERPETUATION THROUGH BUD PROPAGATION. THESE STUDIES ALSO SHOW THAT QUALITY OF FRUIT IS AN INHERENT CHARACTERISTIC AND IS TRANSMITTED AND PERPETUATED THROUGH BUD PROPAGATION.³

These experiments show how the presence of trees of unproductive strains in established citrus orchards are probably due to unintentional propagation of limb variations of like character.³

These facts and the results previously reported emphasize in a most striking manner the great importance of careful bud selection in the commercial propagation of citrus trees, in order to avoid the perpetuation of unproductive and worthless strains.³



All bulletins mentioned are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C. They cost five to ten cents each. Bulletin No. 1333, "Pruning Citrus Trees in the Southwest," contains valuable information with illustrations, and should be in the hands of all citrus growers. From this bulletin we quote:

"Little pruning is necessary in the case of trees grown from buds taken from wood of superior parent trees. Severe pruning of normal citrus trees is unnecessary and injurious.

"Early fruit bearing growth on young trees should not be cut off.

"Pruning should be guided by the behavior of pruned as compared with unpruned trees, as shown by their performance records."



FIGURE 2

Eureka variety, shade tree strain. A rank growing, unproductive tree. Extensive progeny tests prove that buds taken from such trees transmit the rank vegetative characteristics. In order to eliminate this strain, it is highly important that no buds be used from these trees. This is a typical example of the unintentional propagation of undesirable strains in citrus orchards, which can be avoided through careful bud selection, as outlined in this booklet.

Eureka variety, an inherently fruitful strain, propagated from a bud secured from a superior parent tree, selected on the basis of performance records. Such trees have produced consistently heavy crops of high quality, and demonstrate the importance of bud selection.



CO-OPERATION IN SECURING AND DISTRIBUTING BUD WOOD

THE California Fruit Growers' Exchange, a co-operative organization of about 11,000 members, recognizing the commercial importance of this work, established in May, 1917, a department of bud selection. The work of this department is to secure bud wood from superior performance-record trees and distribute it to propagators. The head of this department is a scientifically trained man, who is familiar with the research which has led up to the introduction of improved methods of securing and propagating reliable citrus bud wood. The object of the work is to put into practice the results of the investigation of this subject by the Bureau of Plant Industry in order to improve the quantity and quality of the citrus production in the State as a whole. It is looked upon by those interested as a public service, both to the producer and the consumer, and for this reason has the whole-hearted co-operation and support of every one concerned. This service is performed at cost, and from the beginning has been self-supporting. The operation of this department is briefly outlined in the following paragraphs.¹

KIND OF BUD WOOD

ONLY fruit-bearing bud wood is cut from the parent trees for propagation. As a rule, five large viable buds are obtained on each orange bud stick and ten strong buds with each lemon bud stick. The buds from this young and somewhat immature growth have been found, both experimentally and commercially, to give better results in propagation than the buds from older growth or from sucker wood. On the average, 500 good buds are secured from each full-bearing parent tree during a season.¹

SECURING RELIABLE TREES

THE widespread membership of the co-operative organization, continually advised as to the progress of the work of bud selection and propagation, has been the most effective way through which this information has been made available to the citrus industry as a whole. The officials of the State University and the United States Department of Agriculture, farm journals, and horticultural clubs have co-operated in bringing this work to the attention of all interested persons. At present there seems

1. A. D. Shamel in Yearbook of United States Department of Agriculture, 1919.

to be no good reason why every prospective planter in California should not be able to secure reliable information as to the sources of good citrus trees for planting.¹

This demonstration of the superiority of the trees grown from buds secured in the manner described in this article has been the compelling force that has made the bud-selection work commercially successful.¹

The trees grown from the selected buds have shown unusually early production of heavy crops, and are bearing regular crops of uniformly superior quality; in other words, they are producing fruits similar to those borne by the parent trees.¹

CO-OPERATION AN ESSENTIAL

THE utilization of the results of scientific research in the improvement of citrus fruits through bud selection has largely been made possible through an organized citrus industry. While the investigation of this subject could probably have been carried on without this organization, it was, as a matter of fact, largely encouraged and fostered by it. In the opinion of the writer, the widespread use of the improved methods of bud selection and propagation could not have been so quickly and efficiently introduced commercially in the citrus industry without the active participation of the co-operative growers' organization, the California Fruit Growers' Exchange.

1. A. D. Shamel in Yearbook of United States Department of Agriculture, 1919.

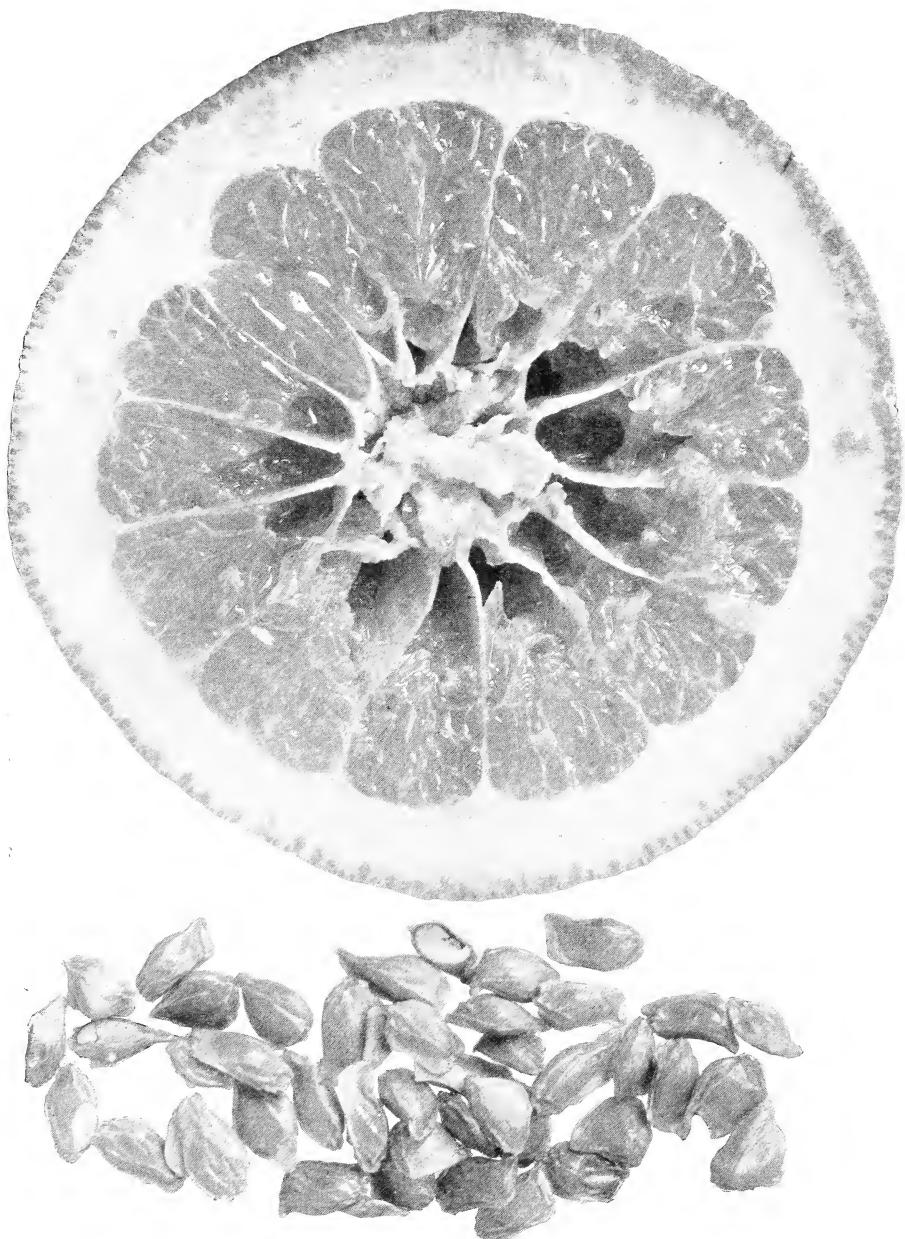


FIGURE 4

Rough, seedy grapefruit; an undesirable sport of the Marsh variety. This illustrates the origin of undesirable strains through careless bud selection.

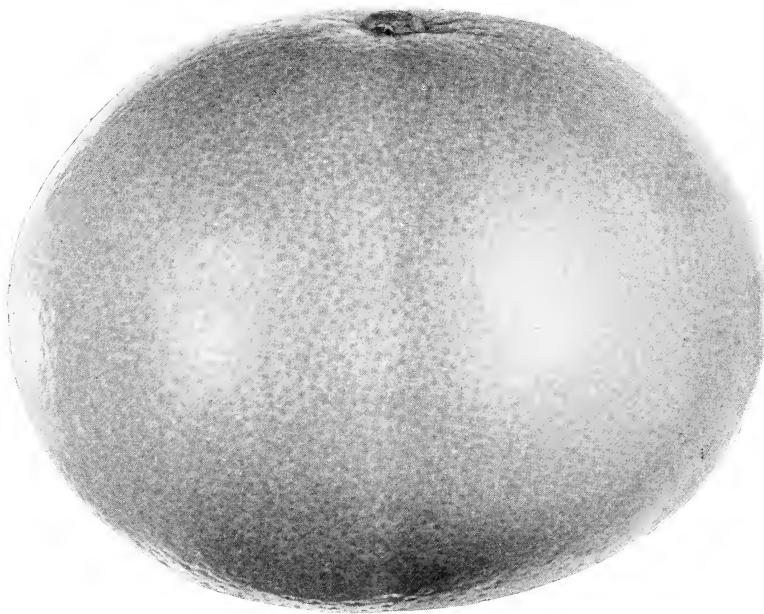
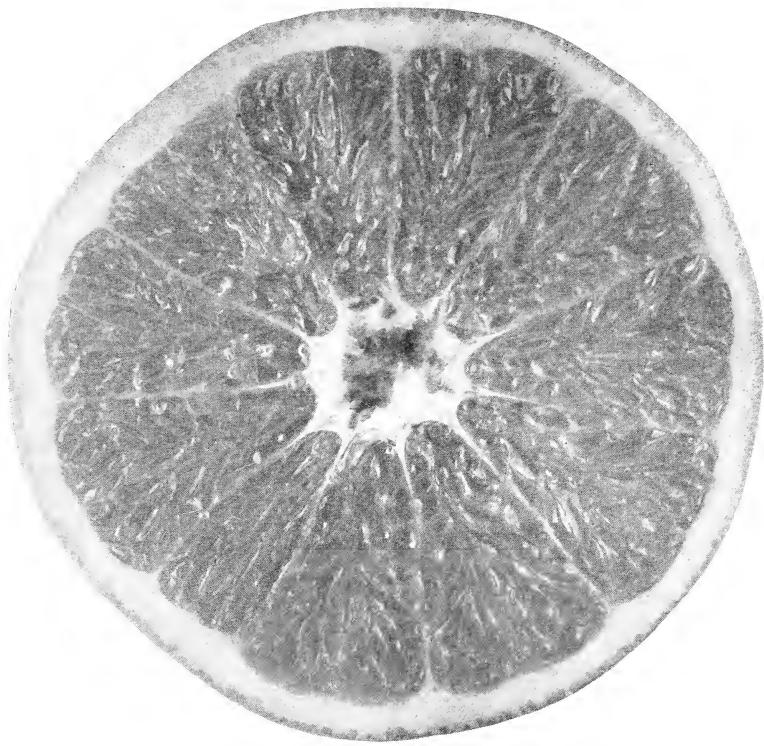


FIGURE 5

Smooth, thin-skinned, seedless grapefruit; a typical example of a desirable type of the Marsh. From a tree in the same Marsh performance record plat as the rough seedy fruit (figure 4), the above illustrates a much improved strain through careful systematic bud selection.

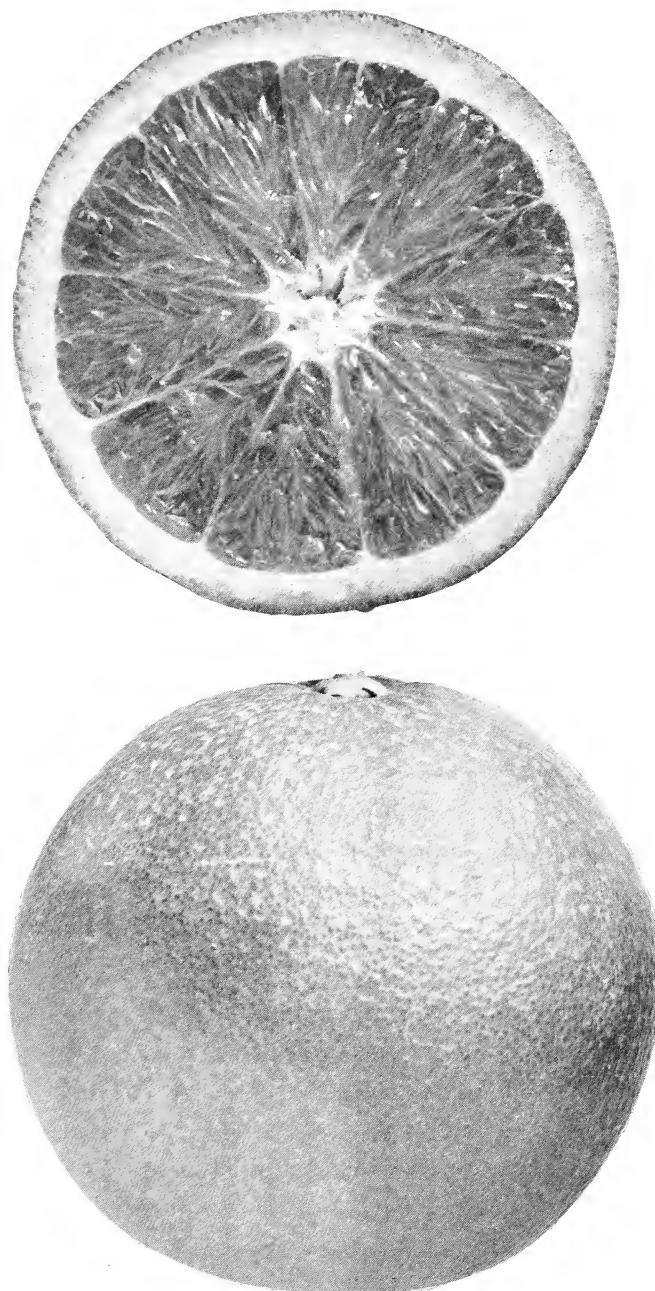


FIGURE 6
A typical thin skin, high quality Washington Navel from a productive tree.
Secured through systematic bud selection.

STATEMENT of DR. H. J. WEBBER

Director of the California Citrus Experiment Station

In a Lecture Before the Lemon Men's Club Field Day Meeting, Riverside, September, 1925

"The great importance of bud selection was forcibly brought to my attention in one of the citrus sections of South Africa, where most of the groves were propagated with little or no understanding of the presence of different types among standard varieties. Whole groves had frequently been grown entirely of inferior and nearly worthless types. In one place during a grove demonstration meeting I had called to the attention of the audience a particular Navel tree in a Washington Navel orchard, which, though a very large and vigorous growing tree, produced a small flat compressed fruit with a very thick rough skin, a wholly worthless fruit in competition with good standard types of the Washington Navel."

"A young man in the rear of the crowd pushed through until he stood directly in front of me, and then, confronting me, requested that I repeat what I had said. I again called attention to the general worthlessness of such types. 'But what can I do', he exclaimed, with tears in his eyes; 'my whole five-year-old grove is budded from that tree, which we thought to be particularly adapted to this country because of its vigor, and it was said to be a Washington Navel'."

"I told him that the only corrective measure was to top work his trees with buds from a known good type and that it would require about three years to rebuild the tops. At this he broke down entirely, exclaiming, 'but what good is that—my money is gone. I have used everything to build the grove, expecting a good return by this time; I can't go on; I'm already broke, with no prospect'."

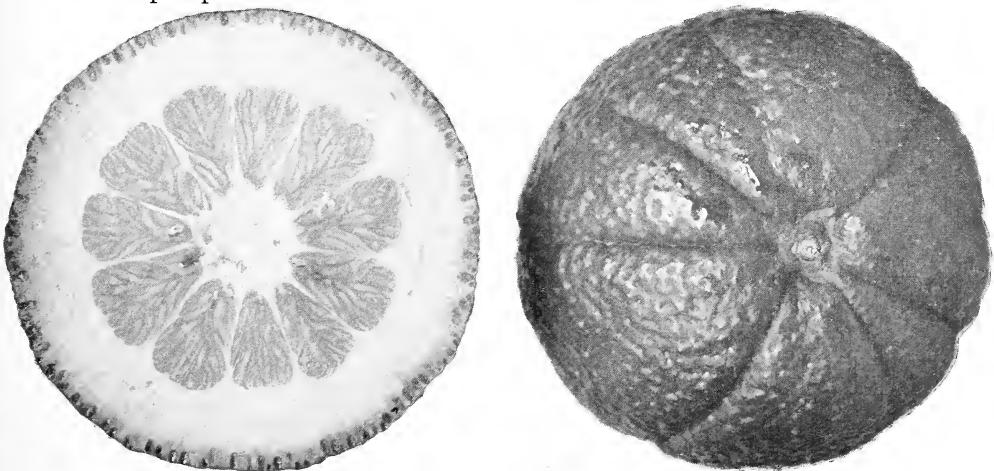


FIGURE 7

"A wholly worthless fruit in competition with good, standard types of the Washington Navel." The worthlessness was wholly due to careless bud selection.



FIGURE 8
VALENCIA: The tree on the right is a vigorous, growing and unproductive Valencia Orange. This was propagated from a limb of an otherwise productive parent tree. The tree on the left was propagated from a productive limb of the same parent tree. This illustration shows the importance of propagating from limbs which are known to produce uniformly good crops of superior quality.

SOUTHERN CALIFORNIA NURSERIES
Office & Nurseries 2142 New York Avenue

Drawer 119

Pasadena, California

Dear Sir:

"BUDDING CLOTH," or "BUDDING TAPE," as used on the Pacific Coast consists of UNIFORM STRONG bleached muslin, saturated in the STRONGEST GRAFTING WAX. There is no secret, mystery or healing value about any "budding cloth." It's only duty is to hold the bud firmly in correct position until Nature, through the function of the Cambium, has time to heal the wounds. For use this cloth is torn into strips about one-fourth of an inch wide, and is wrapped around the stock over the wound, above and below the bud. The ends of the cloth are crossed and twisted together (never tied); the wax is expected to HOLD FAST. If there is drying or burning, or if dirt is admitted, the bud fails. Imitation wax is worse than worthless, for it wastes your work and destroys your faith. We have tested four standard makes of muslin for uniformity and strength, using unwaxed strips one-fourth-inch wide.

Fruit of the Loom broke at 11 to $12\frac{3}{4}$ lbs.

The others broke at from $5\frac{3}{4}$ to $8\frac{1}{2}$ lbs.

Fruit of the Loom costs 3 to 5¢ per yard more than others. We use FRUIT.

GRAFTING WAX FOR Budding Cloth is made from various things, such as:

BEESWAX, costing 50 to 60¢ per lb.

Parafine, costing 11 to 14¢ per lb.

Tallow, costing 8 to 9¢ per lb.

We use pure BEESWAX with a dust of Rosin for hardness and a drop of raw Linseed Oil for Happiness.

We will supply "budding cloth," made as mentioned above at--

55¢ per square yard at our office.

60¢ per square yard post paid on the Pacific Coast.

WAX FOR TOP-WORKING, COVERING PRUNING WOUNDS, ETC. To be applied hot with a brush, made the same as for "budding cloth."

Per half pound, postpaid on the Pacific Coast, 35¢.

Per pound, postpaid on the Pacific Coast, 60¢.

DIRECTIONS FOR HEATING AND USING WAX.

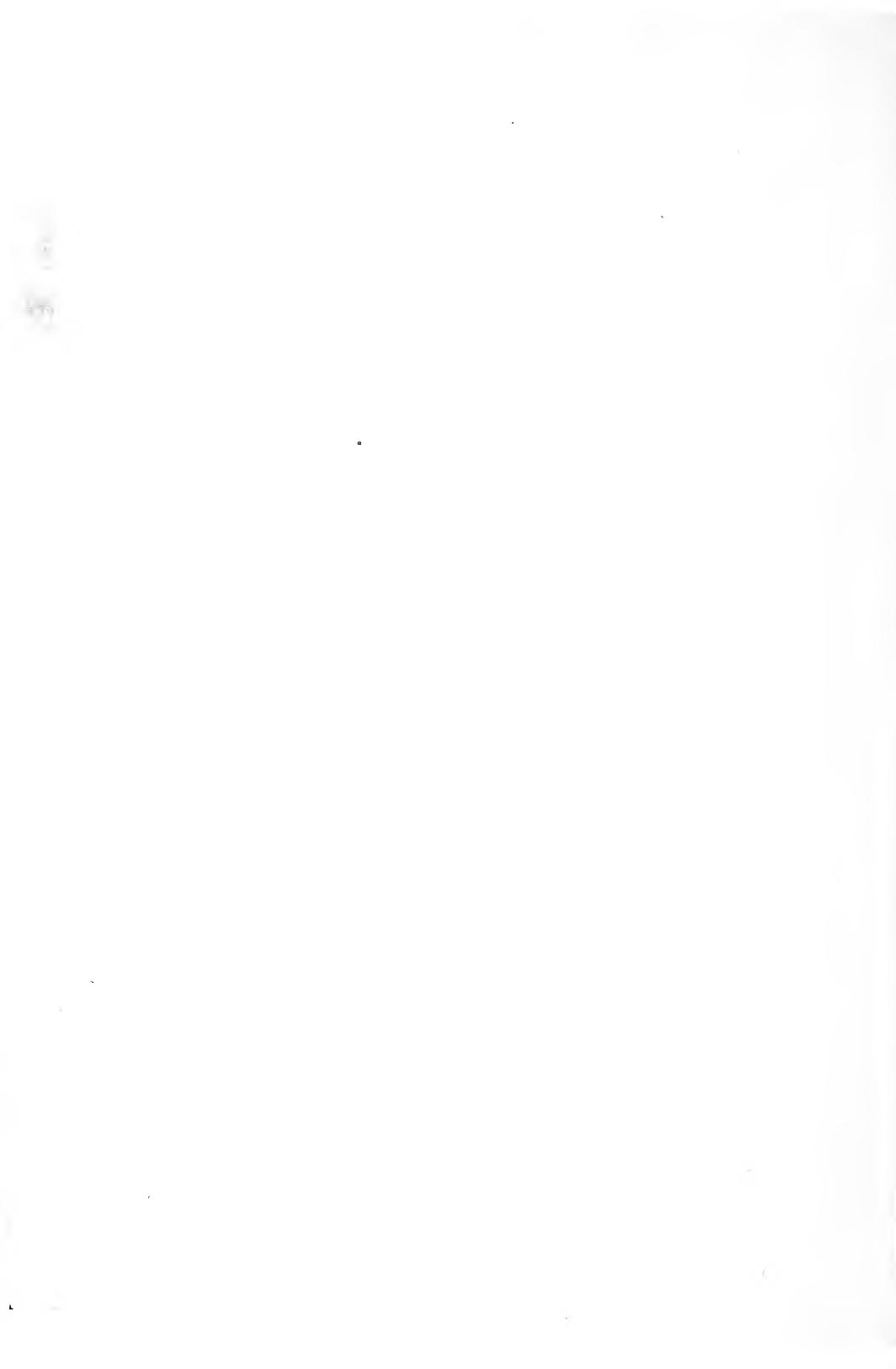
Equipment Needed--An old five-gallon square tin can. About four feet of hay baling wire. Double boiler. Small flat tin pan four to five inches across (fire pan). Brush.

To Get Ready--Cut out top of can; cut a slit down the corner of can to admit handles of double boiler; just below center string across three wires to hold the double boiler over the fire pan. Apply a wire bale to the thing with which to tote it. In the pan mix soot with heater oil to make a paste; this will give a satisfactory fire for the job. Place the fire pan in bottom of can beneath the strung wires. Hot water in lower boiler. Wax in upper boiler. Locate the brush.

Ready--Light the fire, put things in order. GO DO THE JOB. Wax handled this way will never get hot enough to harm the wood of growing trees.

Remittances for "BUDDING CLOTH" and WAX should accompany the order, as we have no facilities for keeping petty accounts. We offer these items for the good of all parties concerned through SUPERIOR SERVICE.

SOUTHERN CALIFORNIA NURSERIES



THE BUDS FROM WHICH OUR CITRUS TREES are grown were furnished by the Fruit Growers Supply Company in co-operation with the U. S. Department of Agriculture through the office of Mr. A. D. Shamel, to the end that we may supply only dependable trees propagated from superior parents of known performance record as shown in this booklet.

We have a good stock of the following trees:

LEMON ON SOUR ORANGE		GRAPEFRUIT, MARSH SEEDLESS
ROOTS		3-year-old trees
Eureka and	3-year-old trees	2-year-old trees
Lisbon	2-year-old trees	1-year-old trees
	1-year-old trees	
ORANGE ON SOUR ORANGE		AVOCADO, Fuerte,
ROOTS		Persimmon,
Valencia and	3-year-old trees	Fugu and Hachiya.
Washington	2-year-old trees	
Navel	1-year-old trees	

EVERGREEN SHRUBS

All have been twice transplanted, thus giving the plants wonderful roots. Last spring the tops were pruned back to the ground; now the plants have heavily branched, fine, clean, vigorous tops.

CALLISTEMON robustus
(*Bottle Brush*)

12 to 20 branches with spread of 3 to 4 feet.

LEPTOSPERMUM laevigatum
(*Australian Tea Tree*)

15 to 20 branches with spread of 3 to 4 feet.

PITTOSPORUM undulatum
6 to 10 branches, 2 to 3 feet tall.

PYRACANTHA yunnanensis

Well branched plants with spread of from 2 to 4 feet.

ERICA (Heather)

Well branched, tops are clean and will give abundant bloom.

E melanthera

2½ to 4 feet tall, well branched.

E persoluta alba.

Compact, climbs 1½ to 2½ feet tall.

Ficus macrophylla (Rubber Tree)

2 to 4 feet tall, clean trunks or branched from the ground.

We want to hear from you. We will be glad to give all information possible. We want your business on a basis of entire satisfaction to both parties.

Our prices are reasonable.

SOUTHERN CALIFORNIA NURSERIES

OFFICE AND NURSERIES

2142 New York Avenue. Telephone Niagara 3197

PASADENA, CALIFORNIA

